WHAT IS CLAIMED IS:

1. Apparatus for converting power from an input source for delivery to a load comprising:

a transformer;

a primary switch connected to drive the transformer;

output circuitry connected to the transformer for delivering an output voltage to the load;

a switch controller adapted to operate the primary switches in a series of converter operating cycles; and

modulation control circuitry adapted to modulate the ON-resistance of the primary switch.

2. The apparatus of claim 1 wherein the modulation control circuitry further comprises an input connected to sense the output voltage and modulates the ON-resistance to control the output voltage.

3. The apparatus of claim 1 wherein the modulation control circuitry further comprises an input connected to sense the output voltage and modulates the ON-resistance to limit an output current.

4. The apparatus of claim 1 wherein the modulation control circuitry further comprises an input connected to sense a load current and modulates the ON-resistance to provide a controlled output current during start-up of the apparatus.

5. The apparatus of claim 4 wherein the input is adapted to sense leakage flux in the transformer.

6. The apparatus of claim 1 wherein the modulation control circuitry varies a voltage used for driving a gate control input of the primary switch.

7. The apparatus of claim 6 wherein the voltage is a supply voltage of a gate drive circuit.

8. The apparatus of 1 further comprising:

a resonant circuit including the transformer having a Q less than 13 and having a characteristic resonant frequency and period;

wherein the primary switch comprises two or more primary switches connected to drive the resonant circuit;

wherein the output voltage is rectified;

wherein the load may vary over a normal operating range; and

wherein each converter operating cycle is characterized by two power transfer intervals of essentially equal duration each interval having a duration less than the characteristic resonant period, during which one or more of the primary switches are ON and power is transferred from the input to the output via the transformer; and

comprising a conversion efficiency from the source to the load having a peak greater than 90% within the normal operating range.

9. The apparatus of claim 1 further comprising:

a resonant circuit including the transformer and having a characteristic resonant frequency and period;

wherein the primary switch comprises two or more primary switches connected to drive the resonant circuit;

wherein the output voltage is rectified;

wherein the load may vary over a normal operating range; and

wherein each converter operating cycle is characterized by

(a) two power transfer intervals of essentially equal duration, during which one or more of the primary switches are ON and power is transferred from the input to the output via the transformer; and

(b) two energy-recycling intervals each having an essentially constant duration over the normal operating range during which the primary switches are OFF;

wherein the switch controller is adapted to turn the primary switches OFF essentially at times when the current in a secondary winding returns to zero; and

magnetizing current is used to charge and discharge capacitances during the energy-recycling intervals.

10. The apparatus of claim 1 further comprising:

a resonant circuit including the transformer and having a characteristic resonant frequency and period;

wherein the primary switch comprises two or more primary switches connected to drive the resonant circuit;

wherein the output voltage is rectified;

wherein the load may vary over a normal operating range; and

wherein each converter operating cycle is characterized by

(a) first and second power transfer intervals during which one or more of the primary switches are ON, power is transferred from the source to the load via the transformer, and voltages and currents in the converter rise and fall at the characteristic resonant frequency; the first and second power transfer intervals being of substantially equal duration over the normal operating range; and

(b) two energy-recycling intervals during which the primary switches are OFF; and

(c) a period having an essentially constant duration over the normal operating range; and

an essentially constant voltage gain K = Vout / Vin at a load current for the power conversion, where Vin is the input source voltage and Vout is the rectified output voltage; and

wherein magnetizing current is used to charge and discharge capacitances during the energy-recycling intervals.

11. A method for converting power from an input source for delivery to a load comprising:

providing a transformer;

providing a primary switch to drive the transformer;

providing output circuitry connected to the transformer for delivering an output voltage to the load;

providing a switch controller adapted to operate the primary switch in a series of converter operating cycles;

providing modulation control circuitry adapted to modulate the ON-resistance of the primary switch.

12. The method of claim 11 further comprising

providing the modulation control circuitry with an input connected to sense the output voltage; and

further adapting the modulation control circuitry to modulate the ON-resistance to control the output voltage.

13. The method of claim 11 further comprising

providing the modulation control circuitry with an input connected to sense the output voltage; and

further adapting the modulation control circuitry to modulate the ON-resistance to limit an output current.

14. The method of claim 11 further comprising

providing the modulation control circuitry with an input connected to sense an output current; and

further adapting the modulation control circuitry to modulate the ON-resistance to provide a controlled output current during start-up of the apparatus.

15. The method of claim 14 wherein the input is adapted to sense leakage flux in the transformer.

16. The method of claim 11 further comprising adapting the modulation control circuitry to vary a voltage used for driving a gate control input of the primary switch.

17. The method of claim 16 further comprising adapting the modulation control circuitry to vary a supply voltage of a gate drive circuit.

18. The method of claim 11 further comprising:

forming a resonant circuit including the transformer having a Q less than 13 and having a characteristic resonant frequency and period;

rectifying the output voltage;

wherein the load may vary over a normal operating range;

wherein the primary switch comprises two or more primary switches connected to drive the resonant circuit;

wherein each converter operating cycle is characterized by two power transfer intervals of essentially equal duration each interval having a duration less than the characteristic resonant period, during which one or more of the primary switches are ON and power is transferred from the input to the output via the transformer; and

providing a conversion efficiency from the source to the load having a peak greater than 90% within the normal operating range.

19. The method of claim 11 further comprising:

forming a resonant circuit including the transformer and having a characteristic resonant frequency and period;

providing output circuitry connected to the transformer for delivering a rectified output voltage to the load;

rectifying the output voltage;

wherein the load may vary over a normal operating range;

wherein the primary switch comprises two or more primary switches connected to drive the resonant circuit;

wherein each converter operating cycle is characterized by

(a) two power transfer intervals of essentially equal duration, during which one or more of the primary switches are ON and power is transferred from the input to the output via the transformer; and

(b) two energy-recycling intervals each having an essentially constant duration over the normal operating range during which the primary switches are OFF; and

using the switch controller to turn the primary switches OFF essentially at times when the current in a secondary winding returns to zero; and

using magnetizing current to charge and discharge capacitances during the energy-recycling intervals.

20. The method of claim 11 for use in a converter where the primary switch comprises two or more primary switches connected to drive a resonant circuit including the transformer and having a characteristic resonant frequency and period, where the output voltage is rectified, and where the load may vary over a normal operating range, the method further comprising:

operating the primary switches in a series of converter operating cycles, each converter operating cycle characterized by:

(a) first and second power transfer intervals during which one or more of the primary switches are ON, power is transferred from the input source to the load via the transformer, and voltages and currents in the converter rise and fall at the characteristic resonant frequency of the resonant circuit; the first and second power transfer intervals being of substantially equal duration; and

(b) two energy-recycling intervals during which the primary switches are OFF;

wherein the switch controller turns the primary switches OFF at times essentially when the current in a secondary winding returns to zero; and

wherein currents in the converter are used to charge and discharge capacitances in the converter during the energy-recycling intervals; and

providing an essentially constant voltage gain K = Vout / Vin at a load current for the power conversion, where Vin is the input source voltage and Vout is the rectified output voltage across the load.

21. The method of claim 11 for use in a converter where the primary switch comprises two or more primary switches connected to drive a resonant circuit including a transformer and having a characteristic resonant frequency and period, where the output voltage is rectified, and where the load may vary over a normal operating range, the method further comprising:

operating the primary switches in a series of converter operating cycles, each converter operating cycle being characterized by:

(a) first and second power transfer intervals during which one or more of the primary switches are ON, power is transferred from the source to the load via the transformer, and voltages and currents in the converter rise and fall at the characteristic resonant frequency of the resonant circuit; the first and second power transfer intervals being of substantially equal duration over the normal operating range; and

(b) two energy-recycling intervals during which the primary switches are OFF; and

(c) a period having an essentially constant duration over the normal operating range; and

using magnetizing current to charge and discharge capacitances during the energy-recycling intervals.